PennDOT Highway Archaeological Survey Team (PHAST)

S.R. 1060 Section A20, Salina Bridge, Ground Penetrating Radar Survey, Westmoreland County
ER No. 2016-8167-129

September 15, 2016

Final

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PennDOT Engineering District 12-0
Federal Highway Administration

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(PHAST/IUP)
Project and Locational Information

1. MPMS #: 81747
2. ER #: 2016-8167-129
3. Project Name: S.R. 1060 Section A20, Salina Bridge Ground Penetrating Radar Survey
4. Preparer’s Name: Dr. William Chadwick, Katherine Peresolak, Brendan Cole, Sarah Henley, Kelsey Schneehagen (PHAST/IUP)
5. Date Prepared: September 15, 2016
6. Project Area County/Counties and Municipality/Municipalities: Westmoreland County/Armstrong County and Bell Township/Kiskiminetas Township
7. Physiographic Zone(s) (per DCNR Map 13, Sevon, 4th Edition, 2000): Pittsburgh Low Plateau Section (Figure 1)
8. Drainage(s):
   a. Sub-Basin: Lower Allegheny Sub-Basin
   b. Watershed: B
   c. Major Stream: Kiskiminetas River
   d. Minor Stream: Wolford Run
9. Insert or attach
   a. A plan map of the project’s general location and
   b. A 7.5’ topographic map of the APE’s precise location. Include a scale, a north arrow, and the name of the appropriate USGS 7.5 minute quadrangle(s). (Figure 2)

Land Use and Setting

Land within the current Ground Penetrating Radar (GPR) survey area is listed as Urban land (UdA) by the Natural Resources Conservation Service (NRCS) (2015). Shelocta-Gilpin channery silt loam (ShF) is mapped to the south of this industrial area and is characterized by 25 to 75 percent slopes. Lobdell silt loam (Lo) is mapped to the north and extends in an east/west direction along the edge of the Kiskiminetas River. Slopes of only zero to three percent and occasional flooding characterize this map unit (NRCS 2015). (Figure 3)

Although it is now an abandoned industrial site, the brick works that once operated here created enough work to employ much of Salina’s inhabitants. Salina itself was built because of the historic industrial activity in the area. The actual brick works buildings were demolished in 2013, though the concrete foundation remains intact.
As described in the Pennsylvania Historical and Museum Commission’s (PHMC) Historic Resource Survey Form for Key # 47503, this property has been used for industrial endeavors since at least 1874, when the Salina Brick Works/ Kier Fire Brick Company began business (Zinn 2015:1-2). Coal and clay mining in the area supported the brick works, and an earlier salt works may have also operated on the property (Zinn 2015). Additional details on the historic industrial land use of the project area can be found in the Phase IA report produced by Michael Baker last year (Lombardi 2015: 13-23).

Landowner w. Contact Information:

Big Visions Corporation c/o Jason J. Harchuck
5384 Davini Street
Sarasota, FL 34238

The Ground-Penetrating Radar (GPR) survey conducted by PHAST is sponsored by PennDOT Engineering District 12-0, on behalf of the Federal Highway Administration (FHWA), and is supplemental to the larger archaeological investigation completed by Michael Baker International in 2015 for the proposed rehabilitation or replacement of the existing historic metal bridge over the Kiskiminetas River and Western Pennsylvania Railroad (Lombardi 2015). Numerous historic resources exist within the preliminary Area of Potential Effect (APE), and the remaining cement and rebar foundation of the Salina Brick Works may have been built over intact historic resources associated with previous industrial activities. The proposed bridge rehabilitation or replacement would likely impact any intact historic archaeological resources that may still exist beneath the existing foundation.

The preliminary GPR APE is 1 hectare (approximately 2.5 acres). Approximately 1.5 acres, or 0.6 ha, were tested during survey on May 18-20, 2016. The PHAST crew completed the GPR survey across the largest remaining feature of the Salina Brick Works, its foundation. Brick and metal rubble, large concrete barriers, nails, and other debris were scattered across the foundation in various places that were mapped using a hand-held Trimble Global Positioning System (GPS) unit. Scattered storms occasionally broke the mostly sunny weather during survey.
Figure 1. DCNR Map 13, Physiographic Provinces of Pennsylvania
Figure 2. 7.5’ USGS Topographic Map, Avonmore 7.5’ Quadrangle, 1993

Figure 3. Web Soil Survey Map
Methodology

The crew and District Archaeologist cleared small trees and vegetation from the concrete foundation/platform and ramp area prior to the survey. Japanese Knotweed was also cut and cleared from the edges of the parking lot. The GPR project area is bounded by the recessed trench in the southern portion of the foundation. Survey did not fully extend to the western foundation edge due to time constraints. The northern boundary aligned with the loading dock edge, except for the northeast corner where only a small grid was surveyed due to a large, fallen tree. The existing Western Pennsylvania Railroad track parallels the platform to the north. Survey continued across a majority of the current parking lot area. The loading ramp extends eastward past the main concrete foundation and marked an even starting point for the parking lot survey grids.

Thirteen different measured grids split the project area, and each grid was surveyed using a 0.5m interval. Grids 1 to 8 were surveyed across the foundation from east to west (Photo 1). The northern edge of the
foundation marked the baseline for each of the eight grids, and survey extended south with transects moving westward at each 0.5m change. Debris on the foundation/platform required reversal transects, as the typical forward transects were blocked (Photo 2). Pieces or areas of debris, intact or rubble metal items, and other features such as small and larger drain shafts were mapped using a hand-held Trimble GPS. Metal and structural cavities are reflected in the data as anomalies, so this measure helped to isolate known/visible versus unknown foundation anomalies in the survey.

Photo 1. Salina Brick Works Platform Area, Grids 1-8, facing northwest
Grids 9 and 10 covered the rubble ramp extending from the eastern edge of the platform (Photo 3). Survey began at the baseline, marked approximately 7.5m east of the rubble ramp base, in the east and ended at the top of the ramp to the west (Photo 4). Transects in this grid were surveyed from 0m in the south to 15.5m in the north.
Grid 11 covered a 6m by 6m area in the very northeastern corner of the platform area (Photo 5). Survey began along a baseline marked in the west and ended at the edge of the platform or 6m in the east. None of the loading dock extension was surveyed using the GPR machine. Transects started from the 0.5m point in the southwest corner of Grid 11 and stopped in the northwest corner of the grid. The first transect began at 0.5m here because of the platform edge, since additional space was required to keep both wheels of the machine on the foundation.
Grid 12, a 20m by 20m block, extended east of Grids 10 and 11 in the parking lot. The loading dock present in this area acted as the baseline for both Grid 12 and Grid 13, each 20m by 20m. Survey began at the dock wall in the north and ended at the wall/brush line in the south. Transects moved west to east.

Grid 13, located immediately east of Grid 12, was surveyed from the north to the south with transects moving from west to east with each new 0.5m swath. Only 4.5m of this final 20m by 20m grid were surveyed due to spent batteries and the low priority of this section compared to areas closer to the bridge. (Photos 6 and 7)

Photo 6. Parking Lot Area for Grids 12 and 13, facing east

Photo 7. Parking Lot Area for Grids 12 and 13, facing east
After each transect in a grid was surveyed, data collection was saved, turned off, and the machine pulled backwards to the initial starting line and over 0.5m to the starting point of the next swath/transect. Data collection was turned on at the baseline and the process repeated. Once data collection finished and GPS points and photographs were taken, the data were processed and analyzed in the lab at Indiana University of Pennsylvania. All grids were processed and combined into one data set with RADAN software before interpretation began.

**GPR Methods**

Ground-penetrating radar (GPR) is an active, non-invasive geophysical method that records contrasts in the dielectric properties of subsurface materials. A pulse of transmitted electromagnetic energy is reflected or absorbed by dielectric contrasts and the intensity and two-way travel-time of the response is recorded to produce a vertical profile. Reflections are generated from deviations in propagation velocity at interfaces between materials of differing relative dielectric permittivity. A two-dimensional GPR profile consists of individual traces, resulting from a single pulse of energy and the resulting reflections at a given location, that are stitched together horizontally to produce an image of dielectric contrasts. In this sense GPR is not providing a stratigraphic profile, rather it is generating a vertical representation of local dielectric contrasts which provides a proxy for subsurface stratigraphic changes.

GPR is an excellent technique for non-invasive prospection for historic archeological features, including wells, privies, graves, and other shaft features, as well as buried building foundations, trenches, and stratigraphic features. GPR excels at identifying these features due the dielectric contrasts that often exist between feature fill and surrounding sediment, visible truncation of internal stratigraphic layers, or high reflection amplitude from intense signal reflection from bricks or stones.

The depth of penetration for GPR depends on numerous factors, including but not limited to the antenna frequency, sediment type, moisture content, compaction, and salt content. Higher frequency antennas are capable of resolving smaller targets and interfaces, though depth penetration is sacrificed. Moisture content increases sediment density through filling of interstitial pore spaces, while compaction causes a similar effect through compressing spaces between particles. The presence of water, salts, and clay particles results in an increase in conductivity and thus a reduction in the quality of GPR data. Clays, shale, and other high conductivity materials may attenuate or absorb GPR signals.

For the survey of the Salina Bridge Replacement project area, PHAST utilized a GSSI SIR-3000 GPR system with a 400 MHz central-frequency antenna. The system is mounted on a Utility Cart and utilizes odometer-triggered collection of 50 traces per meter (1 reading every 2 centimeters). GPR data were collected within several geophysical survey grids atop a concrete Platform Area, Ramp Area, and within the Parking Area (Figure 5). The corners and specific locations were recorded using a sub-meter accurate GPS unit. Post-processing routines for the GPR data are conducted in GSSI’s RADAN Software included position correction (time zero), background removal, and high and low pass filtering. The data were interpreted in both cross-section view (2D), map view (2D) and 3D view. The cross-section and map views allow an analysis of the vertical and horizontal patterning between subsurface anomalies. The 3D view allows visualization of the relationship between cross-section and map views.
Figure 5. GPR Survey Area
Figure 6. Subsurface Features Identified
GPR Results

Each line segment across the Salina Survey Area was examined to identify any anomalies that may represent potential cultural features based on the presence, absence, and structure of anomalies (Figure 5). Based on this analysis a series of features that are interpreted as potential walls were identified below the concrete Platform Area (Figure 6). The identification of these features is based on the examination of both the radargrams and time slices associated with the concrete Platform Area.

Figure 7 is a radargram located near the eastern end of the concrete Platform Area at 15.5m along the X axis of data collection within the GPR grid. Within this radargram five (5) features of interest were identified. Near surface (within the green box) is the signal return from the rebar that is within the concrete Platform Area that extends across the platform. Below this horizon are two pair of distinct features. The first pair (within the red boxes) are interpreted as potential walls. This interpretation is based on the size and extent of these features when compared to the corresponding time slice (Figure 8). These potential walls are found starting at an interpreted depth of approximately six (6) feet below the platform surface and extending to an interpreted depth of about ten (10) feet below the platform surface. These potential wall features range in width from approximately two (2) to three (3) feet in width and are found both east and west in additional radargrams. In addition to the two potential walls, there are two features (within the orange boxes) that present as a strong signal within both the radargrams and time slices. These are interpreted as some type of constructed feature of unknown type. These features present as being approximately seven (7) to ten (10) feet below the surface of the platform and ranging between six (6) and nine (9) feet wide. These unknown features run generally east to west while also diverging in position while trending to the west (Figure 6 and Figure 8).
Figure 7.
Platform Area @ Y 15.5m

Figure 8.
Platform Area @ Y 15.5m and Z 9.40ft
Figure 9 is a radargram located near the western end of the concrete Platform Area at 91m along the X axis of data collection within the GPR grid. Within this radargram two (2) features of interest were identified. Near surface (within the green box) is the signal return from the rebar that is within the concrete Platform Area that extends across the platform. The second (within the red box) is a feature interpreted as a potential wall. This interpretation is based on the size and extent of the feature when compared to the corresponding time slice (Figure 10). This potential wall is found starting at an interpreted depth of approximately six (6) feet below platform surface and extending to an interpreted depth of about nine (9) feet below the platform surface. This potential wall feature has a width of approximately two (2) feet in width and is found both east and west as can be seen in Figure 10.

Figure 9.
Within the Ramp Area (Figure 5) of the survey no features of interest were identified based on the radargrams and the time slices. The radargram (Figure 11) collected at 3.5 meters south along the X axis of the GPR grid and the time slice (Figure 12) at the interpreted depth of 7.5 feet below the ground surface are used to show the relationship between a debris filled area and the original ground surface. Within Figure 11 is identified a surface (brown line) that descends from the surface as data collection moved to the west. At the ground surface, the location where this line appears to descend is actually where the landscape begins to rise from the Parking Area to the Platform Area (Figure 5). Thus in reality, the surface that appears to descend is actually horizontal and the materials above that line represent a fill deposit that creates the apparent ramp from the Parking Area to the Platform Area. The interpretation of this debris filled sequence is based on observing the radargrams and time slices in 3D (Figure 13). In Figure 13 the transition from the subsurface and the debris filled sequence is a distinct line that is traced across the time slice (the brown line). The interpreted debris fill is defined by the chaotic signal return in the data.
Figure 11.

Ramp Area: Grid 9/10 @ 3.5m

East

West

fill/debris
Figure 12.
Ramp Area: Grid 9/10 @ Z 7.75ft

Figure 13.
Ramp Area: Grid 9/10 @ Y 3.5m and Z 7.75ft
Within the Parking Area (Figure 5) of the survey only one feature of interest was identified based on the radargrams and the time slices. The radargram (Figure 14) collected at 15.5 meters along the X axis within the GPR grid depicts and feature of interest (within orange oval) within the area. This feature extend minimally east and west of this location but is amorphous in shape. In addition to this one feature, it is suggested that the GPR survey may have picked up the boundary between potential floodplain and fill deposits and bedrock (maroon line). The interpretation that this bedrock boundary is present is based on the transition from areas where there are clear horizontal boundaries potentially representing flood deposits and where there is no reflective signal. This pattern is also found when looking at the time slices of the area (Figure 15). When the radargrams and the time slices are combined from the Parking Area, the potential bedrock boundary (maroon line) becomes very distinct (Figure 16).

Figure 14.
Figure 15.

Parking Area: Grid 12/13 @ Z 5.6ft
Conclusions

Based on the examination of the radargrams and the time slices form the Salina Project Area, the primary area with features of interest are located within the Platform Area of the overall survey (Figure 5). The Platform Area had anomalous features that defined linear patterns across the area of two types. The first type of linear patterns were small features ranging in depth from approximately six (6) to ten (10) feet below the platform surface and ranged in width from two (2) to three (3) feet interpreted as likely walls. The second feature of interest in the Platform Area are the two large linear features that diverge moving west. These features of unknown origin ranged in depth from seven (7) to ten (10) feet below the platform surface and range in width between six (6) and nine (9) feet.

Per the requirements of Section 106 of the National Historic Preservation Act and its implementing regulations (36CFR800), if the proposed project introduces significant subsurface disturbance into the Platform Area, the anomalies encountered in the GPR survey will have to be “ground-truthed” via mechanical excavation, and evaluated for their National Register eligibility. If they prove to be eligible to the National Register, the potential effects of the project will have to be assessed, and any adverse effects will have to be resolved, probably through mitigation of some kind. Due to the logistical and workplace safety implications within this part of the project area, it is likely that the National Register evaluation and any subsequent on-site mitigation effort would incur substantial costs (on the order of hundreds of thousands of dollars). In our opinion, project designers should seek ways to avoid direct, subsurface
disturbance in this part of the project area if possible. The use of this area for equipment staging and material storage would not affect any National Register features or deposits, since they are well protected by the concrete pad.

The Ramp Area and Parking Area do not have industrial features of interpreted cultural interest. Although the GPR survey did not pick up any features of interest, the landscape position of these areas have potential for buried prehistoric cultural features. Any future archaeological investigations in these locations should focus on identifying any undisturbed pre-Industrial landscapes and landforms, and sample them for intact pre-Contact or Early Historic features or deposits.
References


PROJECT CHECKLIST: Please fill out a copy of this checklist and include it with your initial report submission, (including with management summaries or draft reports). This form may be downloaded and expanded as needed, but please do not eliminate any fields.

1. **Report Title** S.R. 1060 Section A20, Salina Bridge, Ground Penetrating Radar Survey
2. **PI** Angela Jaillet-Wentling ( ☑ MA, ☐ PhD) / **Firm** or Institution PennDOT
3. **Report Date** (Month/Day/Year) September 15, 2016
4. **Number of Pages** 24
5. **Agency Name** FHWA Federal ☑ State ☐
6. **Project Area County/Municipality** (list all)
<table>
<thead>
<tr>
<th>County</th>
<th>Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westmoreland &amp; Armstrong</td>
<td>Bell and Kiskiminetas Townships</td>
</tr>
</tbody>
</table>
7. **Project Area Drainage(s)**, (list all)
   | Sub-basin                      | Watershed                           |
   | Lower Allegheny Sub-Basin     | B                                   |
8. **Project Area Physiographic Zone(s)** (list All) (Use DCNR Map 13 compiled by W.D. Sevon, Fourth Edition, 2000.)
   | Physiographic Zone             | Pittsburgh Low Plateau Section       |
9. **Report Type** (some reports are combinations, check as many as apply to this report)
   - ☐ Phase IA/Sensitivity Study
   - ☑ Phase I
   - ☐ Phase II
   - ☐ Phase III
   - ☐ Historic Structures
   - ☐ Geomorphology
   - ☐ Determination of Effects
   - ☐ Other _____
10. **Total Project Area** 1 hectares
11. **Low Probability/Disturbed Areas** - hectares = - % of project area
12. **Phase I Methods used for total project** (check as many as apply)
   - ☐ shovel tests,
   - ☐ controlled test units/deep tests,
☐ surface survey, ☐ informant interview, ☑ other: GPR survey

13. **Total Number of Sites** Encountered/Phase I 1
   - Total Sites Tested/Phase II _____
   - Total Sites Excavated/Phase III _____

14. **Updated PASS Information:** Please complete an updated PASS form for each site reported by this report. Updated forms need only include the new information and the site number and name.

15. **PASS Site Specific Information:** In addition, the following pages must also be completed for each site. Complete only the portions that pertain to the current report. If the report is a stand-alone Phase II, you do not need to fill in the Phase I methods, since they should have been included in the summary form for the previous report.
15. PASS Site Specific Information

Please complete the following **for each site** reported by this report.

PASS NUMBER 36WM####

A. Phase I Methods (how the site was located - check as many as apply)

- ☐ shovel tests, ☐ controlled test units/deep tests,
- ☐ surface survey, ☐ informant interview, ☑ other: GPR survey

B. Phase II Methods

- ☐ controlled surface collection
- ☐ controlled excavation w. screening of plowzone, > 5 units
- ☐ mechanical stripping of plowzone (_____%)
- ☐ deep excavation units
- ☐ remote sensing
- ☐ other ______

square meters of site tested: _____ sq. m
% of site area tested: _____ %

C. Phase III Methods

- ☐ controlled surface collection
- ☐ controlled excavation w. screening of plowzone, > 5 units
- ☐ mechanical stripping of plowzone _____%
- ☐ deep excavation
- ☐ block excavations
- ☐ remote sensing
- ☐ environmental reconstruction (soils, floral, pollen)
- ☐ dietary reconstruction (floral, faunal)
- ☐ intensive lithic analysis (functional)
- ☐ intensive lithic analysis (technological)
- ☐ raw material sourcing
- ☐ ceramic analysis (seriation)
- ☐ ceramic analysis (functional)
- ☐ blood residue
- ☐ other ______

square meters of site tested: _____ sq. m
% of site area tested: _____ %
Recommendations (normally completed only after Phase II):

-- NR Eligibility recommendation
  ☐ eligible, ☐ ineligible, ☐ undetermined

-- reasons for determination (check as many as apply; expand as needed)

  ☐ eligible: Criterion A. Explain ______
  ☐ eligible: Criterion B. Explain ______
  ☐ eligible: Criterion C. Explain ______
  ☐ eligible: Criterion D:
    ☐ settlement patterning (intersite patterning)
    ☐ intrasite artifact patterning
    ☐ features
    ☐ radiocarbon dating
    ☐ organic preservation
    ☐ evidence of culture change through time
    ☐ stratified ☐ temporally discrete clusters
  ☐ burials/human remains
  ☐ technological
  ☐ economics
  ☐ ethnicity
  ☐ dietary
  ☐ other (specify): ______

☐ ineligible
  ☐ disturbed
  ☐ ephemeral occupation
  ☐ redundant information
  ☐ undatable
  ☐ other (specify): ______

E. Artifacts/Collections
☐ will be donated to the State Museum of Pennsylvania
  ☐ gift agreement from private owner enclosed
  - or -
  ☐ transfer of responsibility from State Agency enclosed
  ☐ election of repository from Federal Agency enclosed
  ☐ artifacts washed/marked/cataloged following State Museum guidelines
-- collection will be submitted by ______(date)
☐ will be donated to other approved repository (this option must be negotiated with the BHP and State Museum or stated as stipulation in MOA)
☐ curation agreement enclosed
☐ artifacts washed/marked/cataloged following host guidelines
-- collection will be submitted by _____(date)

☐ will be retained by land owner (☐ whole or ☐ partial collection)
☐ expanded documentation enclosed for items retained
☐ proof enclosed that owner was notified of the option to donate the collection to the State Museum and chose to retain the collection:
   ☐ letter from owner indicating desire to retain collection
   - or -
   ☐ agency or representative discussed donation option with owner on _____(date)
   - and -
   ☐ copy of letter and certified letter receipt indicating that the owner was offered this option in writing.